WHAT IS CLAIMED IS:

1. A method for forming a corrosion and heat protective coating on a substrate comprising the steps of:

forming a nickel base coating layer on said substrate;

applying a layer of zinc over said nickel base coating layer; and

diffusing the zinc into said nickel base coating layer.

2. A method according to claim 1, wherein said nickel base coating layer forming step comprises electrodepositing a layer of nickel or nickel alloy onto a surface of said substrate.

3. A method according to claim 1, wherein said nickel base coating layer forming step comprises forming a layer of nickel or nickel alloy having a thickness in the range of 2.0 to 20μm.

4. A method according to claim 1, wherein said nickel base coating layer forming step comprises forming a layer of nickel or nickel alloy having a thickness in the range of from 2.0 to 14.0μm.

5. A method according to claim 1, wherein said nickel base coating layer forming step comprises forming a layer of nickel or nickel alloy having a thickness in the range of from 8.0 to 11μm.

6. A method according to claim 1, wherein said nickel base coating layer forming step comprises forming a layer of nickel or nickel alloy on a steel substrate.

7. A method according to claim 1, wherein said nickel base coating layer forming step comprises forming a layer of nickel alloy on a component used in a gas turbine engine.

8. A method according to claim 1, wherein said nickel base coating layer step comprises forming a layer of a nickel alloy selected from the group consisting of a nickel cobalt alloy, a nickel iron alloy, a nickel manganese alloy, a nickel molybdenum alloy, and a nickel tin alloy.

9. A method according to claim 1, wherein said zinc layer applying step comprises forming an electroplating solution containing a zinc metal concentration of between 8.0 and 45.0 g/l and electroplating said layer of zinc onto said nickel alloy layer.

10. A method according to claim 1, wherein said zinc layer applying step comprises forming a layer of zinc having a thickness in the range of 0.8 to 14μm.

11. A method according to claim 1, wherein said zinc layer applying step comprises forming a layer of zinc having a thickness in the range of 2.0 to 14μm.

12. A method according to claim 1, wherein said zinc layer applying step comprises forming a layer of zinc having a thickness in the range of 4.0 to 7.0μm.

13. A method according to claim 1, wherein said diffusing step comprises carrying out a thermal diffusion cycle in at least one of an atmospheric and an inert gas oven at a temperature in the range of 600 to 800°F for a time of at least 100 minutes.

14. A method according to claim 13, wherein said thermal diffusion cycle comprises heating said nickel base coated substrate with said layer of zinc to a first temperature in the aforesaid range for a time period in the range of 80 to 100 minutes and then to a second temperature higher than the first temperature for a time period in the range of 20 to 60 minutes.

15. A method according to claim 1, further comprising immersing said substrate in a phosphate trivalent chromium conversion solution.

16. A method according to claim 15, wherein said immersing step is performed after said zinc layer applying step and before said diffusion step.

17. A method according to claim 15, wherein said immersing step is performed after said diffusing step.

18. A method according to claim 15, wherein said immersing step comprises immersing said substrate into a solution comprising a water soluble trivalent chromium compound, a water soluble fluoride compound and a corrosion resistance improving additive.

19. A substrate having at least one surface and a zinc diffused nickel alloy coating on said at least one surface.

20. A substrate according to claim 19, wherein said substrate is formed from steel.

21. A substrate according to claim 19, wherein said substrate comprises a component used in a gas turbine engine.

22. A substrate according to claim 19, wherein said zinc diffused nickel alloy coating provides corrosion resistance and heat resistance at temperatures in excess of 900°F.

23. A substrate according to claim 19, wherein said coating has a nickel or nickel alloy layer into which zinc atoms have diffused and a zinc layer into which nickel atoms have diffused.

24. A substrate according to claim 23, wherein said nickel alloy layer is formed by an alloy selected from the group consisting of a nickel cobalt alloy, a nickel iron alloy, a nickel manganese alloy, a nickel molybdenum alloy, and a nickel tin alloy.

25. A substrate according to claim 23, wherein said nickel alloy is formed from a nickel cobalt alloy having a cobalt content in the range of 7.0 to 40wt%.

26. A component for use in a gas turbine engine comprising:

a steel substrate; and

a zinc diffused nickel alloy coating on said steel substrate.